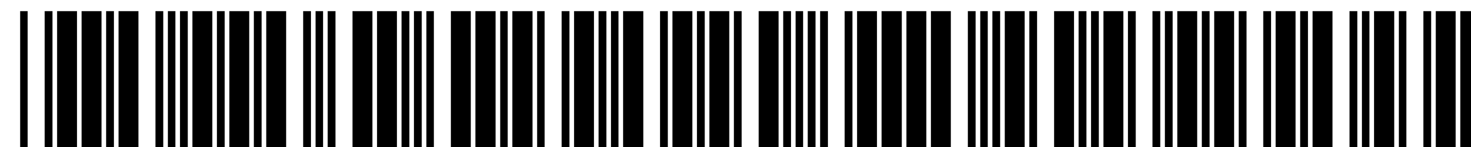
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Shima et al.

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(45) **Date of Patent: Feb. 17, 2015**

(54) **CATALYTIC CVD EQUIPMENT, METHOD FOR FORMATION OF FILM, PROCESS FOR PRODUCTION OF SOLAR CELL, AND SUBSTRATE HOLDER**

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(21) Appl. No.: **13/435,646**

(22) Filed: **Mar. 30, 2012**

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

Oct. 2, 2009 (JP) 2009-230589

(51) **Int. Cl.**

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C23C 16/44	(2006.01)
C23C 16/24	(2006.01)
H01L 21/687	(2006.01)

(52) **U.S. Cl.**
CPC *C23C 16/44* (2013.01); *C23C 16/24* (2013.01); *H01L 21/68757* (2013.01)
USPC **219/444.1**

(58) **Field of Classification Search**
USPC 219/444.1, 385, 443.1
See application file for complete search history.

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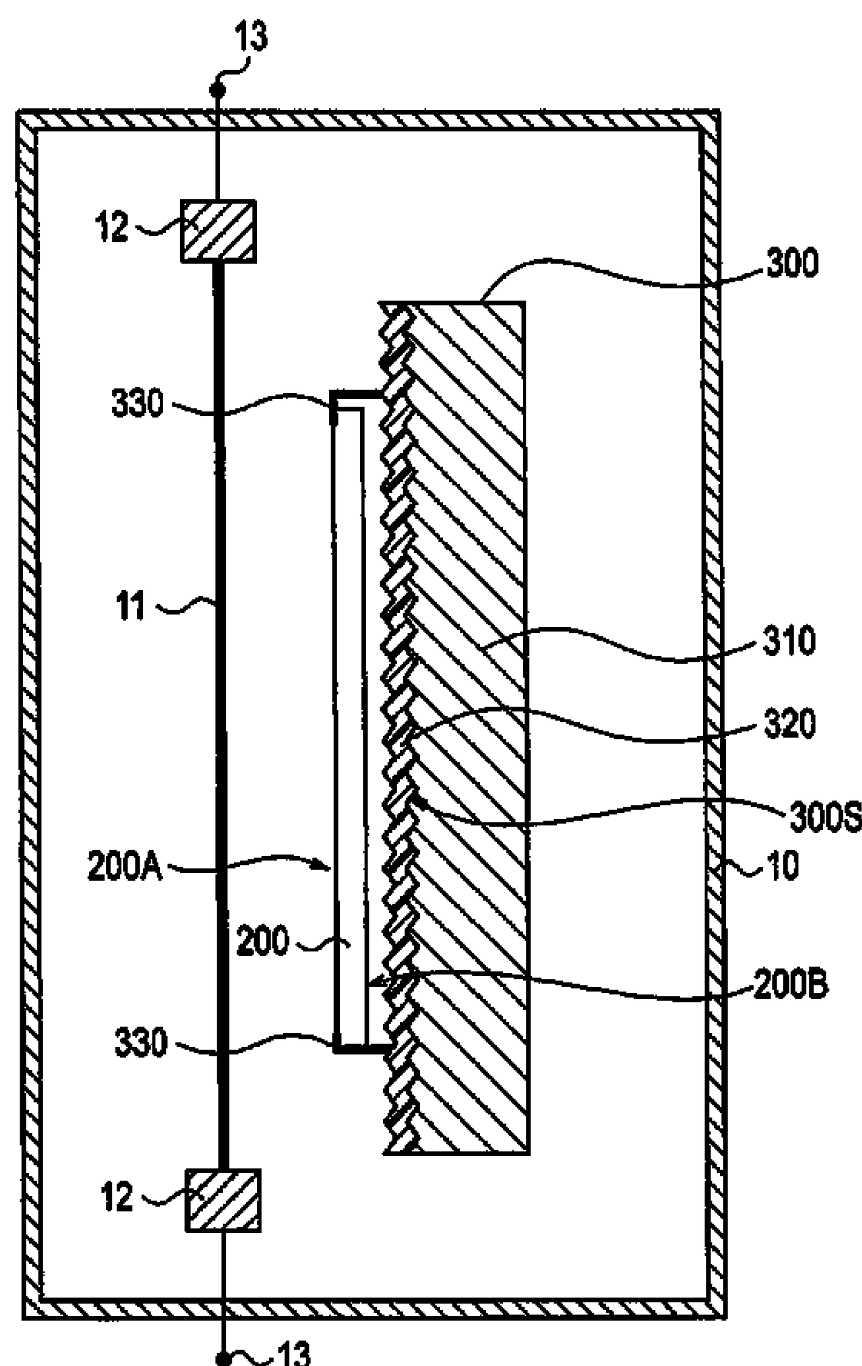
(57) **ABSTRACT**

In a catalytic CVD equipment, a holder includes an antireflective structure for preventing reflection of a radiant ray that is ejected from the catalytic wire toward the side of the substrate.

8 Claims, 6 Drawing Sheets



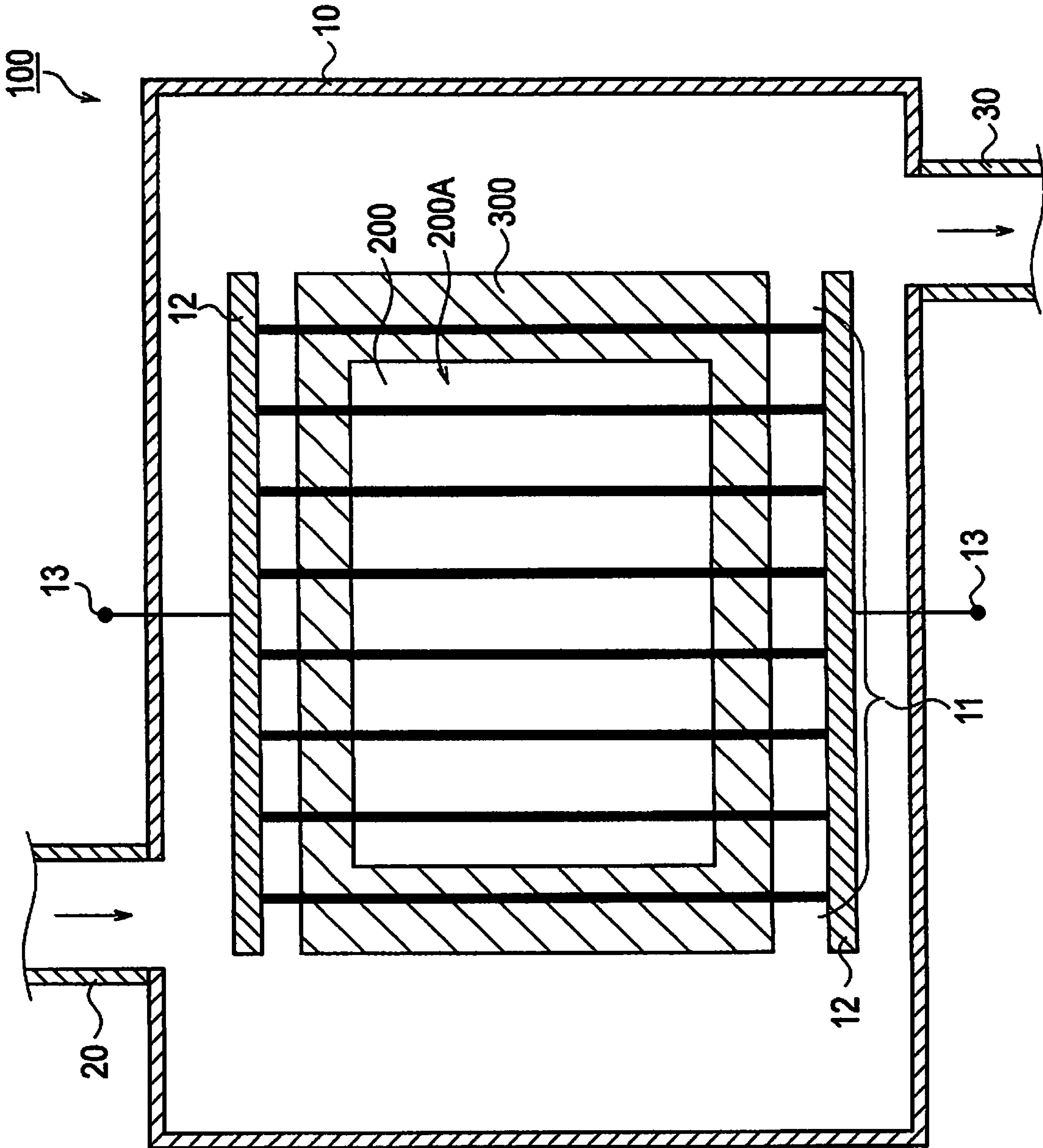


FIG. 1

FIG. 2

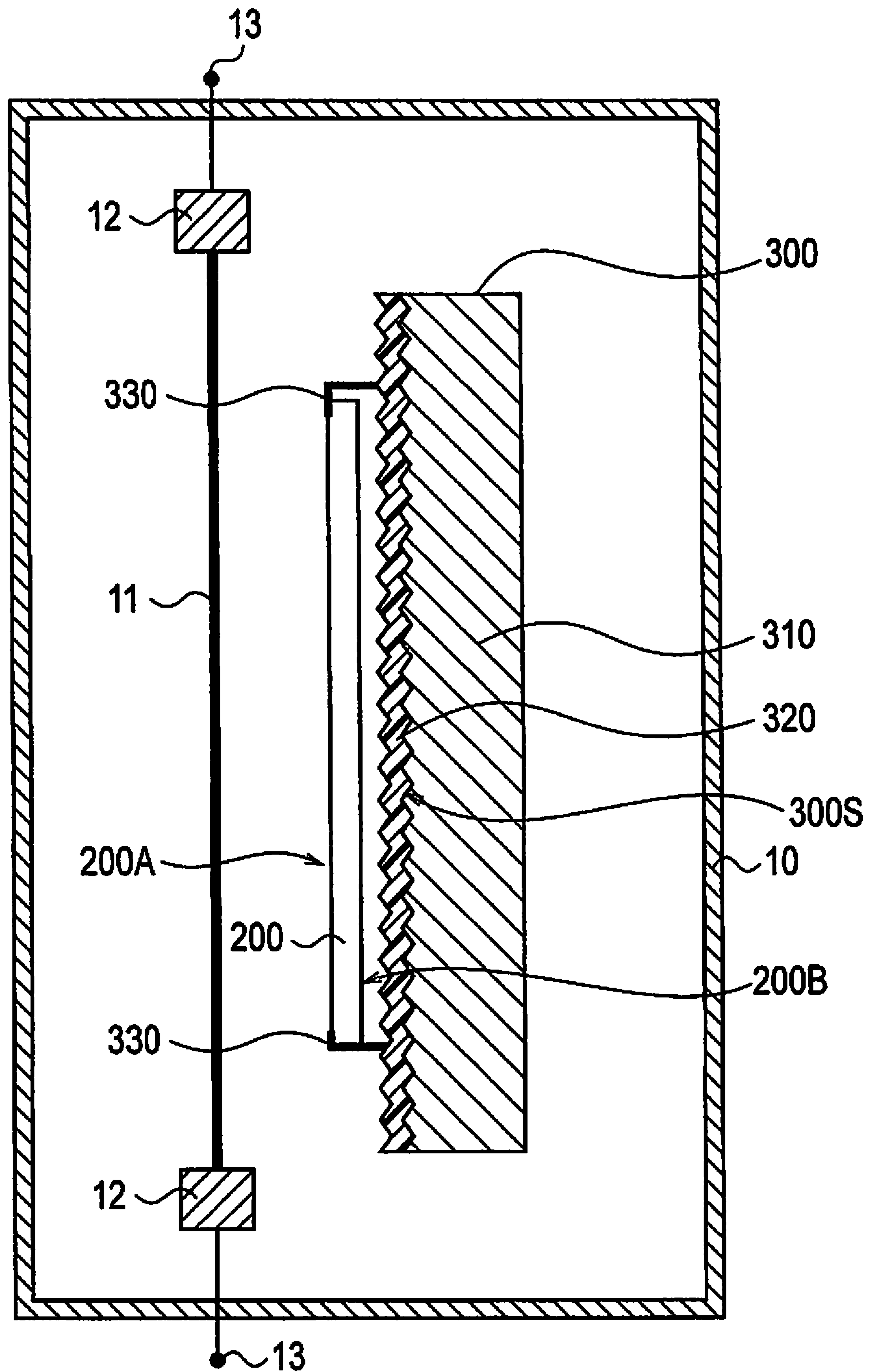


FIG. 3

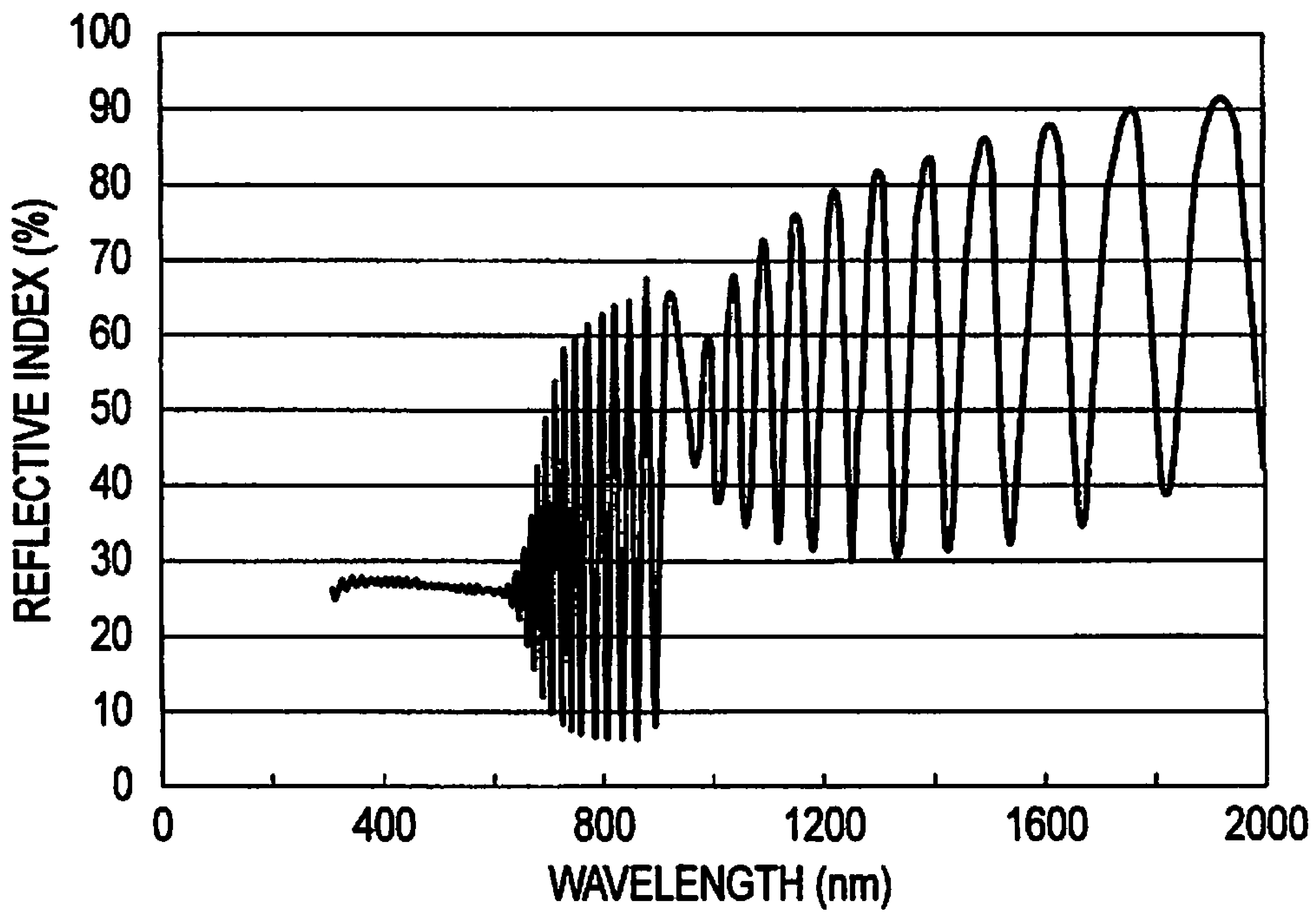


FIG. 4

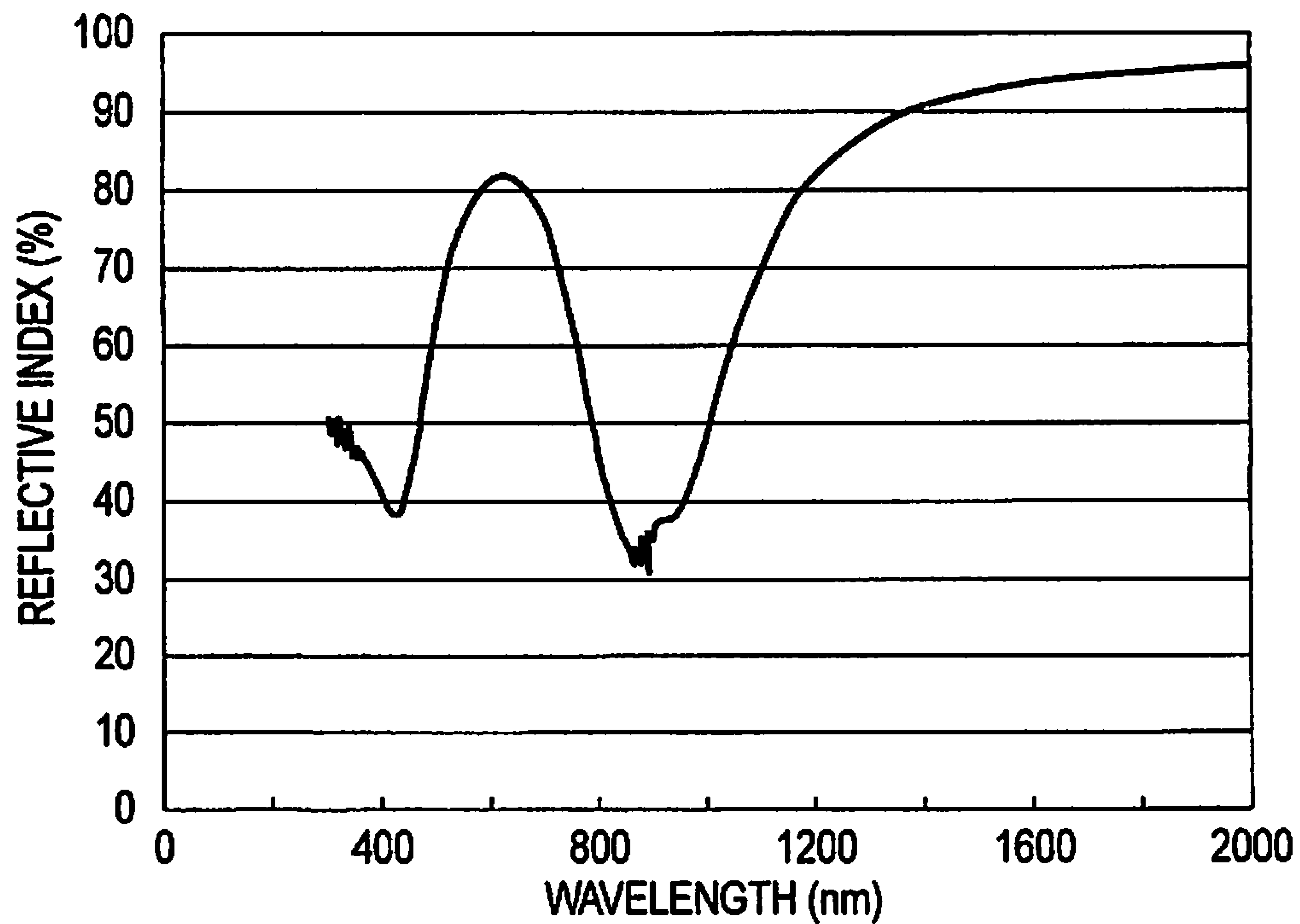


FIG. 5

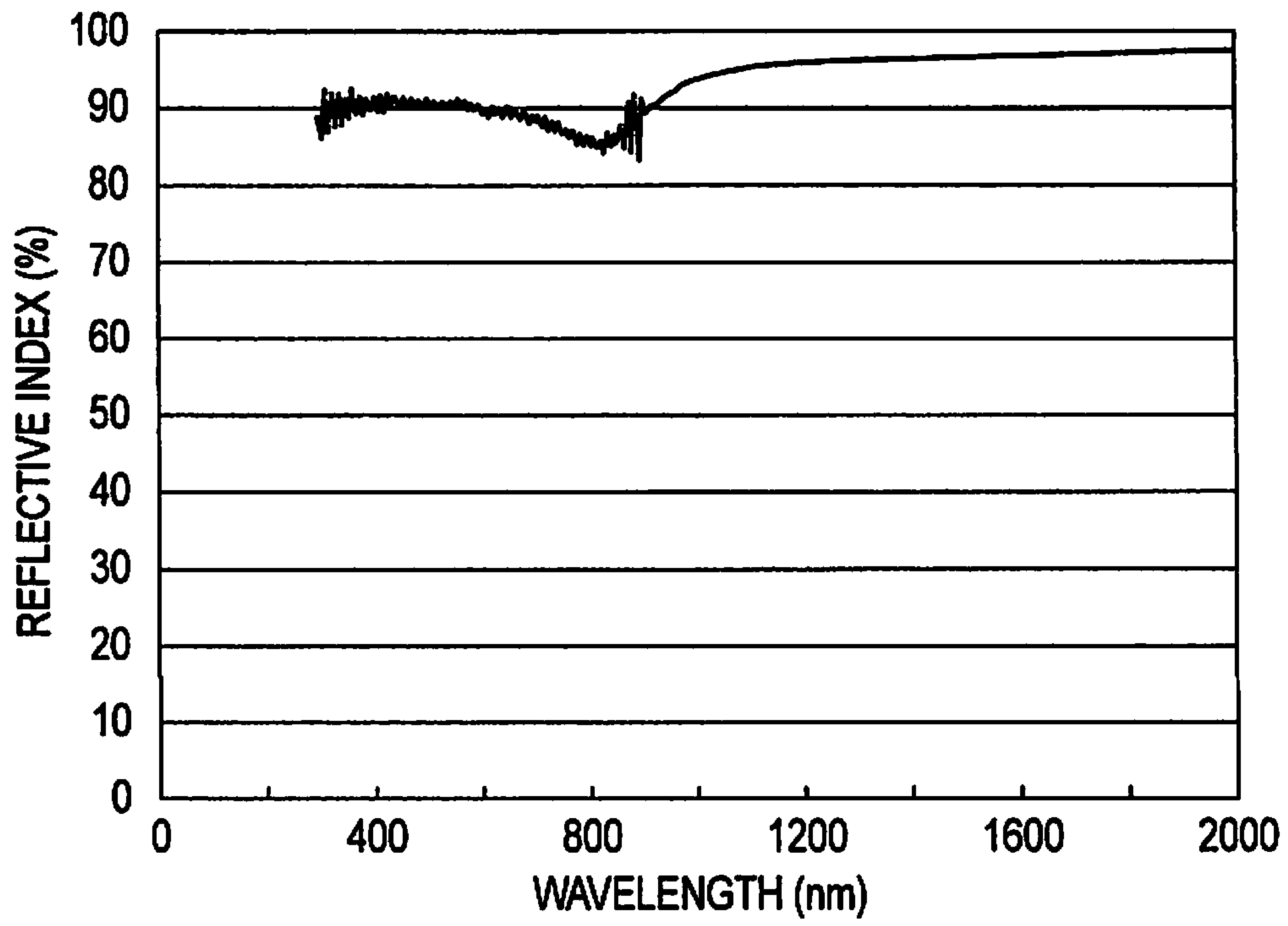


FIG. 6

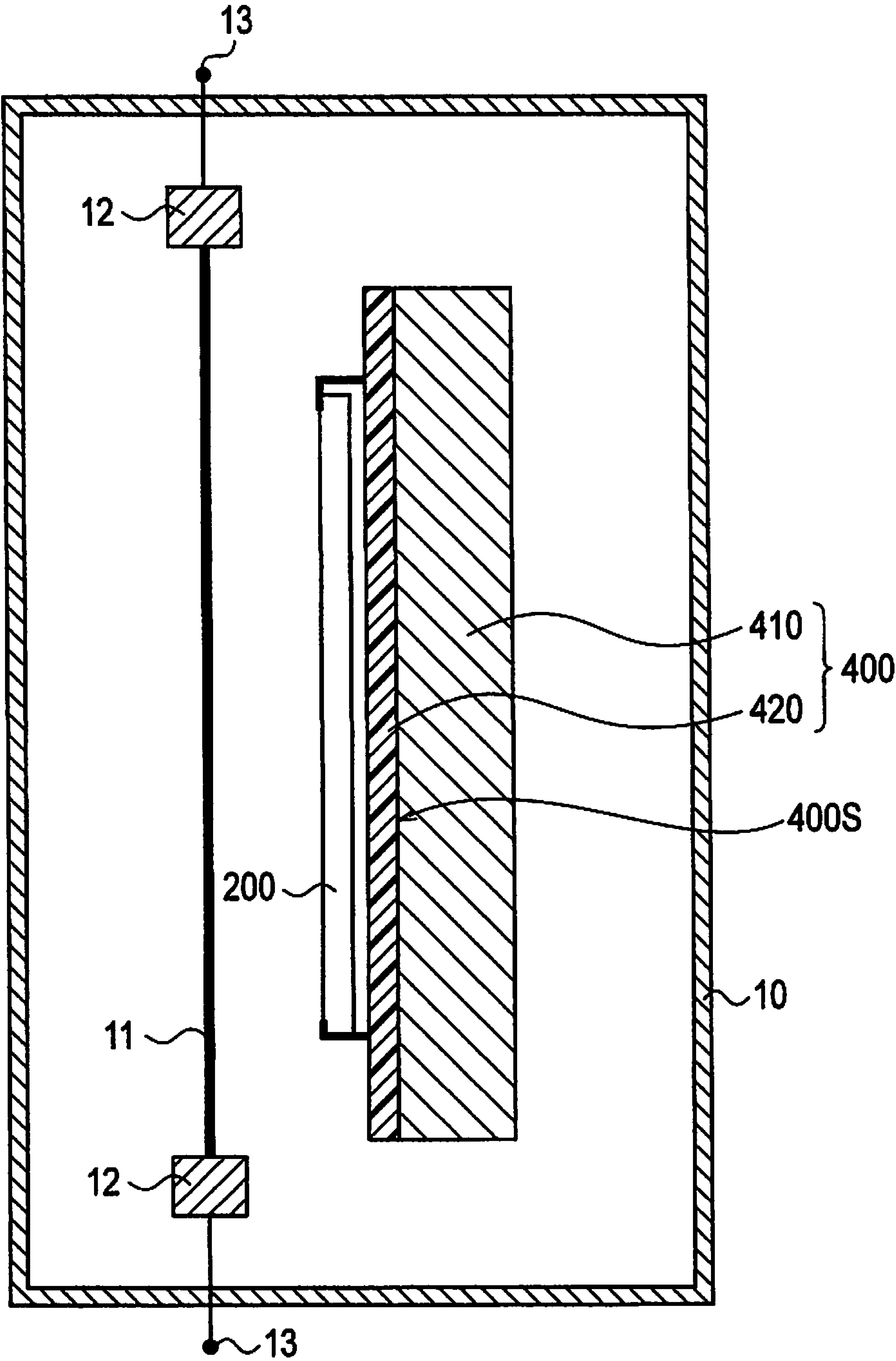
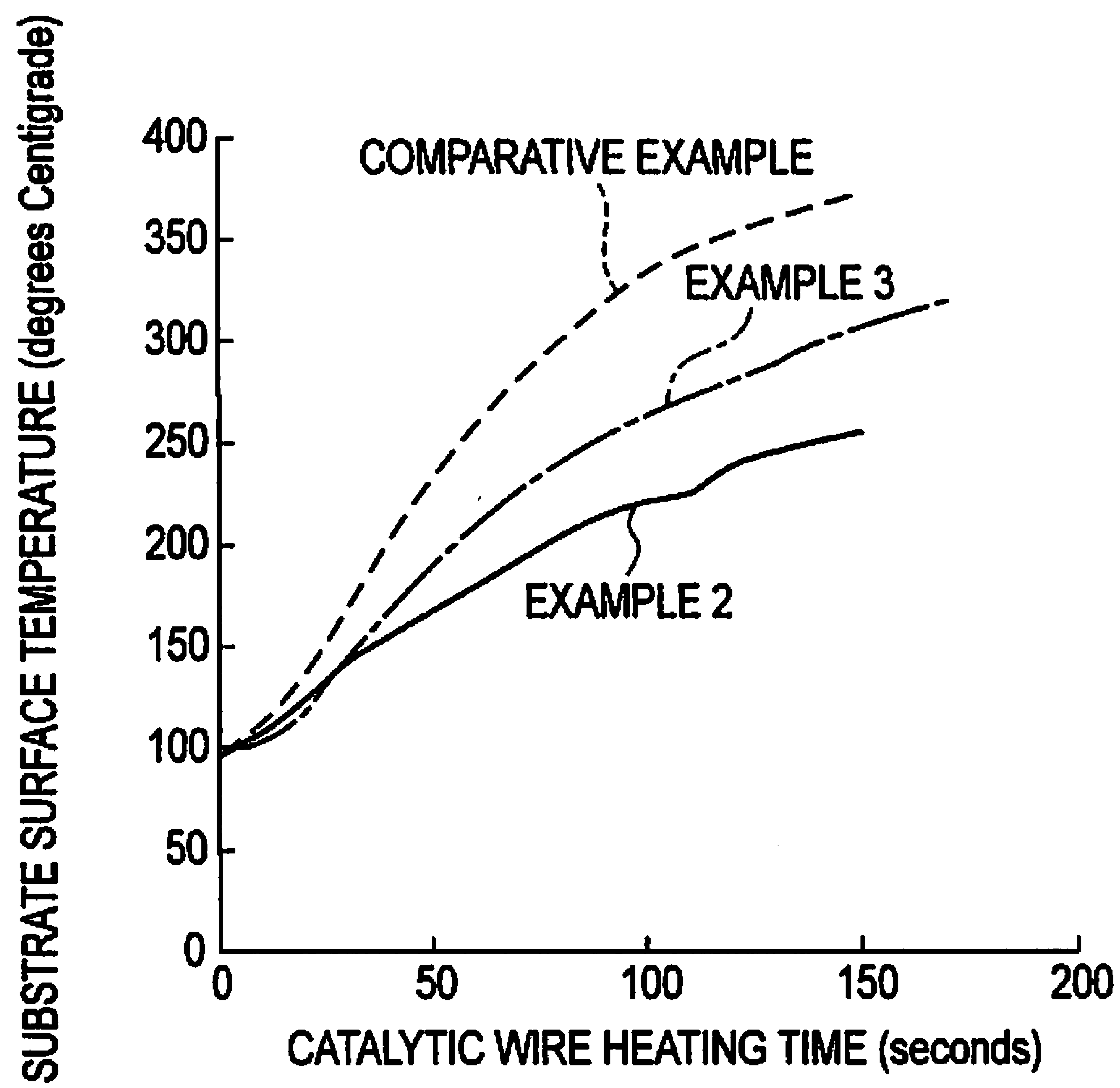


FIG. 7



CATALYTIC CVD EQUIPMENT, METHOD FOR FORMATION OF FILM, PROCESS FOR PRODUCTION OF SOLAR CELL, AND SUBSTRATE HOLDER

CROSS REFERENCE

This application is a Continuation of PCT Application No. PCT/JP2010/067285 filed on Oct. 1, 2010, and claims the priority of Japanese Patent Application No. 2009-230589 filed on Oct. 2, 2009, the content of both of which is incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to a catalytic CVD equipment which is employed in a catalytic CVD technique, a method for formation of film, a process for production of solar cell, and a substrate holder.

BACKGROUND ART

As a method for forming a predetermined deposited film on a substrate at the time of producing a variety of semiconductor devices such as solar cells, in general, a CVD technique (a Chemical Vapor Deposition technique) is conventionally known. As one kind of such CVD technique, in recent years, a catalytic CVD technique utilizing Catalytic Chemical Vapor Deposition has been discussed (Patent Document 1, for example).

In the catalytic CVD technique, a raw material gas to be supplied into a reaction chamber is decomposed by employing a catalytic wire that is made of heated tungsten, molybdenum or the like and then a deposited film is formed on a substrate that is held on a holder. The catalytic CVD technique is expected as a method for formation of film, by which a substrate surface or a deposited film surface is less adversely affected, since such plasma discharge in a plasma CVD technique is not utilized.

PRIOR ART DOCUMENT(S)

Patent Document

Patent Document 1: Japanese Unexamined Patent Application Publication No. 2005-327995

SUMMARY OF THE INVENTION

In the abovementioned catalytic CVD technique, a catalytic wire is heated up to the order of about 1,600 degrees Centigrade to 2,000 degrees Centigrade. In this duration, a radiant ray (such as an infrared ray or a visible ray, for example) is ejected from the catalytic wire, and a substrate absorbs the radiant ray by itself, and is thereby heated.

At this time, the substrate is easily overheated up to a temperature which is higher than a preferred temperature to form a quality film by absorbing the radiant ray that passes through the substrate and then is reflected by means of the holder. If a film is deposited on the substrate in such a state, the film quality of the deposited film may be degraded. In addition, such a problem does not occur with only a semiconductor device, but can generally occur in a case where a deposited film is formed by means of the catalytic CVD technique.

The present invention has been made in view of the above-described circumstance, and it is an object of the present invention to provide a catalytic CVD equipment, a method for formation of film, a process for production of solar cell, and a substrate holder that are capable of restraining overheating of a substrate.

A catalytic CVD equipment according to the present invention, is summarized as a catalytic CVD equipment for performing formation of film by supplying a raw material gas to a catalytic wire that is installed and heated in a reaction chamber and then depositing generated decomposed species on a substrate that is held on a holder in the reaction chamber, the holder including an antireflective structure for preventing reflection of a radiant ray that is ejected from the catalytic wire.

In a catalytic CVD equipment according to the present invention, the antireflective structure may include an antireflective film.

In a catalytic CVD equipment according to the present invention, the antireflective film may include a silicon-containing film.

In a catalytic CVD equipment according to the present invention, the silicon-containing film may have at least one structure of an amorphous structure and a crystalline structure.

In a catalytic CVD equipment according to the present invention, the antireflective film may include a mixed crystal film.

In a catalytic CVD equipment according to the present invention, the antireflective structure may have a concave-convex structure that is provided so as to be opposed to the substrate.

A catalytic CVD equipment according to the present invention is summarized as a catalytic CVD equipment for performing formation of film by supplying a raw material gas to a catalytic wire that is instated and heated in a reaction chamber and then depositing generated decomposed species on a substrate that is held on a holder in the reaction chamber, the holder including a silicon-containing film that is formed on a holding face for holding the substrate.

A method of formation of a film according to the present invention is summarized as a method of formation of a film, said method including the step of depositing a film on a substrate to perform formation of film, wherein formation of film of the film is performed by employing the catalytic CVD equipment according to the foregoing present invention.

A process for production of a solar cell according to the present invention is summarized as a process for production of a solar cell, said process including the step of depositing a film on a substrate to perform formation of film, wherein formation of film of the film is performed by employing the catalytic CVD equipment according to the foregoing present invention.

A substrate holder according to the present invention is summarized as a substrate holder for performing formation of film by supplying a raw material gas to a catalytic wire that is installed and heated in a reaction chamber and then depositing generated decomposed species on a substrate that is held on a holder in the reaction chamber, the holder including an antireflective structure for preventing reflection of a radiant ray that is ejected from the catalytic wire.

According to the present invention, there can be provided a catalytic CVD equipment that is capable of restraining overheating of a substrate and easily controlling a temperature of the substrate in a preferred temperature range. In addition, there can be provided a method for formation of film and a process for production of solar cell, which are capable of providing a deposited film with its good film quality and solar cell with its good solar cell property, by employing the cata-

lytic CVD equipment. Further, there can be provided a substrate holder that is capable of restraining overheating of a substrate in a case where the holder is employed in the catalytic CVD equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram showing a configuration of a catalytic CVD equipment **100** according to an embodiment.

FIG. **2** is a schematic diagram showing a configuration of a holder **300** according to the embodiment.

FIG. **3** is a view showing a reflective index of a sample **1** according to the embodiment.

FIG. **4** is a view showing a reflective index of a sample **2** according to the embodiment.

FIG. **5** is a view showing a reflective index of a sample **3** according to the embodiment.

FIG. **6** is a schematic diagram showing a configuration of a holder **400** according to the embodiment.

FIG. **7** is a graph depicting a change of each of the surface temperatures of substrates that are held on holders of Example 2, Example 3, and Comparative Example.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, a catalytic CVD equipment according to an embodiment of the present invention will be described with reference to the drawings. It is to be noted that, in the following description of drawings, the same or similar constituent elements are designated by the same or similar reference numerals.

However, it should be kept in mind that the drawings are schematic, and a rate of each dimension is different from actual one. Therefore, specific dimensions or the like should be determined in consideration of the following description. In addition, it is a matter of course that portions with their different dimensional interrelationships or rates are included in the drawings.

[Configuration of Catalytic CVD Equipment]

Hereinafter, a configuration of a catalytic CVD equipment employed in the embodiment will be described with reference to the drawings. FIG. **1** is a schematic diagram showing a configuration of a catalytic CVD equipment **100**. The catalytic CVD equipment **100** is a device that performs formation of film by supplying a raw material gas to a heated catalytic wire which is instated in a reaction chamber, and depositing generated decomposed species onto a substrate held on a holder in the reaction chamber. As shown in FIG. **1**, the catalytic CVD equipment **100** is provided with a reaction chamber **10**, a gas supply pipe **20**, and a gas exhaust pipe **30**.

The reaction chamber **10** is provided with a catalytic wire **11** and a mount portion **12**. In the reaction chamber **10**, a holder **300** for holding a substrate **200** is housed.

The catalytic wire **11** is heated to thereby decompose a raw material gas to be supplied into the reaction chamber **10**. Both ends of the catalytic wire **11** are mounted on the mount portion **12**, and are disposed perpendicular to a bottom face of the reaction chamber **10**. The catalytic wire **11** is disposed so as to be opposed to a holding face whose side is to hold the substrate **200** of the holder **300**. While a distance between the catalytic wire **11** and a film-formed face of the substrate **200** is appropriately set, for example, the distance is set on the order of 100 mm to 140 mm. The catalytic wire **11** is electrically powered to be thereby heated to a temperature to an extent such that the raw material gas can be decomposed (for example, 1,600 degrees Centigrade to 2,000 degrees Centigrade). The raw material gas is decomposed by means of the catalytic wire **11** and then the decomposed species reaches the top of a first main face **200**A of the substrate **200**, whereby a deposited film (such as a semiconductor film or a SiN film, for example) is formed on the substrate **200**.

The catalytic wire **11** can be made of a material such as Ta, Mo, or W. In addition, the catalytic wire **11** may have different kinds of layers on surface. One example of such layer includes a tantalum wire of which a borate layer is formed on surface. Further, the catalytic wire **11** whose diameter is 0.3 mm to 2.0 mm, preferably 0.5 mm to 1.0 mm, is employed.

The mount portion **12** is made of a material having its electrical conductivity. A terminal **13** that is electrically connected to the mount portion **12** is connected to a power source, although not shown. As a power source, there can be employed a constant current power source, a constant voltage power source, or constant current/constant voltage power source that is capable of both of constant current control and constant power control.

The gas supply pipe **20** communicates with the reaction chamber **10** and a gas cylinder (not shown) containing a raw material gas (such as SiH_4 and H_2). The gas supply pipe **20** is a flow path for supplying the raw material gas into the reaction chamber **10**.

The gas exhaust pipe **30** is a flow path for discharging the raw material gas from the inside of the reaction chamber **10**. In addition, the gas exhaust pipe **30** is capable of discharging the gas that remains in the reaction chamber **10** in order to keep the inside of the reaction chamber **10** in a vacuumed state.

[Configuration of Holder]

Next, a configuration of the holder **300** will be described with reference to FIG. **2**. FIG. **2** is a side view of the holder **300** that is disposed in the reaction chamber **10**.

As shown in FIG. **2**, the holder **300** has a holding face **300S**, a substrate portion **310**, an antireflective film **320**, and a holding structure **330**.

The substrate portion **310** is a substrate for holding the substrate **200** on the holding face **300S**. The substrate **310** can be made of a metal material with its good thermal conductivity such as aluminum or stainless steel.

The substrate **200** is a substrate on which a deposited film is to be formed. The substrate **200** is formed in a plate-like shape, for example, and has: a first main face **200**A on which a deposited film is to be formed; and a second main face **200**B that is provided at the opposite side of the first main face **200**A. As shown in FIG. **2**, the second main face **200**B of the substrate **200** is opposed to the holding face **300S**.

Here, a concave-convex structure is formed on the holding face **300S**. The size of the concave-convex structure is on the order of 2 microns to 5 microns in height and on the order of 2 microns to 5 microns in pitches, for example. Such a concave-convex structure can be formed by applying blast treatment to the holding face **300S**, for example.

Although the concave-convex structure may be formed in a substantially full area of the holding face **300S**, it is preferable that the structure be formed in at least an area that is opposite to the second main face **200**B of the substrate **200** of the holding face **300S**.

The holding structure **330** is mounted on the substrate portion **310**. It is sufficient if the holding structure **330** hold the substrate **200** on the holding face **300S**, for example, a configuration of a substrate press mask and a mask mount member can be employed. The holding structure **330** may be detachable from the substrate portion **310**.

The antireflective film **320** is formed on the holding face **300S**. In the embodiment, the antireflective film **320** covers a

concave-convex structure that is formed on the holding face **300**S. The antireflective film **320** reduces reflection of a radiant ray toward the side of the substrate **200** due to the substrate portion **310** by performing absorption or the like of the radiant ray that is ejected from the catalytic wire **11** and then passes through the substrate **200** (such as an infrared ray or a visible ray, for example).

In addition, the antireflective film **320** can be made of a silicon-containing film that contains silicon. According to such a silicon-containing film, a radiant ray permeating through the substrate **200** can be absorbed, thus making it possible to reduce reflection of the radiant ray toward the side of the substrate **200** by means of the substrate portion **310**.

FIG. **3** is a view showing a reflective index of a sample **1** that is fabricated by forming an amorphous silicon film with its thickness of 3 microns on an aluminum film with its thickness of 250 nm, the aluminum film being formed on a glass substrate, by employing a plasma CVD technique. FIG. **4** is a view showing a reflective index of a sample **2** fabricated by forming an amorphous silicon film having a thickness less than the thickness of the sample **1** on an aluminum film with its thickness of 250 nm, the aluminum film being formed on a glass substrate, by employing a plasma CVD technique. FIG. **5** is a view showing a reflective index of a sample **3** without an amorphous silicon film, the sample being fabricated by forming an aluminum film with its thickness of 250 nm on a glass substrate. From these figures, it is found that the reflective index of each of the samples 1 and 2 with an amorphous silicon film is smaller than that of the sample **3** without an amorphous silicon film.

It is to be noted that, as a silicon-containing film, there can be employed a film substantially entirely containing an amorphous structure as seen in amorphous silicon film or a film partially containing a crystalline structure as seen in finely crystalline silicon film. Alternatively, the silicon-containing film may substantially entirely contain a crystalline structure. In addition, as a material of silicon-containing film, there can be employed the one containing a silicon alloy such as silicon germanium or silicon carbide without being limitative to silicon. Further, a silicon-containing film may or may not contain impurities for valence electron control. While such a silicon-containing film can be formed by means of a catalytic CVD technique, a plasma CVD technique, or a vacuum vapor deposition technique, the abovementioned catalytic CVD equipment **100** can be employed; and therefore, the catalytic CVD technique is preferable in particular. It is sufficient if the antireflective film **320** have a thickness of about 1.5 microns to 3 microns, for example.

In addition, the antireflective film **320** can be formed by employing a mixed crystal film such as alumina, titania, and chrome oxide. According to the antireflective film **320** employing such a mixed crystal film, the radiant ray that permeates through the substrate **200** is scattered on a crystalline interface, thus making it possible to change an incident angle of the radiant ray to the antireflective film **320**. Therefore, the radiant ray that permeates through the substrate **200** can be confined in the antireflective film **320**, thus making it possible to reduce reflection of the radiant ray toward the side of the substrate **200**. It is to be noted that such mixed crystal film can be fabricated by means of a variety of methods such as vapor deposition technique, plasma thermal spraying technique or reactive sputtering technique. For example, by employing the vapor deposition technique, aluminum that is housed in melting pot is heated and evaporated in an oxygen atmosphere, whereby a mixed crystal film of alumina can be formed. In addition, by employing the plasma thermal spraying technique, oxygen is employed as an activation gas, a plasma jet with its high temperature and high speed exceeding 10,000 degrees Centigrade is generated between an anode and a cathode by means of direct current arc discharge, aluminum powder is entered into the plasma jet, melting and acceleration is performed, and a film is formed, whereby a mixed crystal film of alumina can be formed. Alternatively, by employing the reactive sputtering technique, oxygen is introduced at the time of sputtering employing an aluminum target, whereby a mixed crystal film of alumina can be formed. Further, by employing such a mixed crystal film, even in a case of employing the holder **300** on which an amorphous silicon film cannot be formed, the antireflective film **320** can be formed on the holding face **300**S.

Although the antireflective film **320** may be formed in a substantially full area of the holding face **300**S, it is preferable that the film be formed in at least an area that is opposite to the second main face **200**B of the holding face **300**S.

Herein, the antireflective film **320** that is formed on the holding face **300**S is provided as one example of an "antireflective structure" according to the present invention. The "antireflective structure" used here denotes a structure for preventing reflection toward the side of the substrate **200** by means of the substrate portion **310** of the radiant ray that is ejected from the catalytic wire **11** and permeates through the substrate **200**.

[Functions and Advantageous Effects]

In the catalytic CVD equipment **100** according to the embodiment, the holder **300** has the antireflective film **320** as an antireflective structure for preventing reflection toward the side of the substrate **200** by means of the substrate portion **310** of the radiant ray that is ejected from the catalytic wire **11**.

Therefore, in a case where a deposited film is formed on the first main face **200**A of the substrate **200**, reflection of the radiant ray (such as an infrared ray or a visible ray, for example) that is ejected from the catalytic wire **11** and permeates through the substrate **200** is reduced by means of the antireflective film **320**, and part of the energy of the radiant ray is transmitted as a heat to the substrate portion **310** with its good thermal conductivity. Thus, the substrate **200** is restrained from being overheated, and a temperature of the substrate **200** is easily controlled in a preferred temperature range, thus making it possible to form a deposited film having its good film quality. Accordingly, a deposited film is formed by employing such a holder **300**, thereby making it possible to obtain its good film property.

In addition, in the embodiment, the antireflective structure has a concave-convex structure that is formed on the holding face **300**S. In this case, an optical path length in the antireflective film **320** of the radiant ray that is reflected on the holding face **300**S can be increased, thus making it possible to absorb or confine the radiant ray more effectively. As a result, overheat of the substrate **200** can be restrained more significantly.

Further, adhesion between the holding face **300**S and the antireflective film **320** can be improved, thus making it possible to restrain release of the antireflective film **320** from the holding face **300**S.

Other Embodiments

While the present invention was described by way of the foregoing embodiment, it should not be understood that the statements and drawings forming part of this disclosure limit this invention. From this disclosure, a variety of substitute embodiments, examples, and operating techniques would have been self-evident to one skilled in the art.

For example, while, in the foregoing embodiment, a concave-convex structure was formed on the holding face **300**S, such concavities and convexities may not be formed. That is, as shown in FIG. **6**, there may be employed a holder **400** in which an antireflective film **420** is formed on a flat holding face **400**S of a substrate portion **410**.

In addition, while, in the foregoing embodiment, the antireflective structure of the holder **300** was formed by means of the antireflective film **320** this structure is not limitative thereto. For example, in the antireflective structure, the holder **300** may be a structure having an opening that is formed in an area that is opposite to the second main face **200**B, that is, in an area that is opposite to the catalytic wire **11** while the substrate **200** is sandwiched therebetween. In this case, the radiant ray that is ejected from the catalytic wire **11** and permeates through the substrate **200** passes through an opening of the holder **300**; and therefore, the radiant ray that is reflected by means of the holder **300** can be reduced.

Further, while, in the foregoing embodiment, the antireflective structure was formed integrally with the holder **300**, this structure is not limitative thereto. For example, the antireflective structure may be a structure that is formed independently of the holder **300**, and this structure may be mounted to the holder **300**.

Furthermore, although not specifically mentioned in the foregoing embodiment, the catalytic CVD equipment **100** and the holder **300**, according to the present invention, can be employed to form a film other than a semiconductor film such as an amorphous Si film or a semiconductor film such as a SiN film. Moreover, the catalytic CVD equipment **100** and the holder **300** can be employed in a process of production of semiconductor devices such as solar cells that are provided with at least one of a semiconductor film and another non-semiconductor film. Thus, by employing the catalytic CVD equipment **100** or the holder **300** according to the present invention, the substrate **200** is restrained from being overheated, and a temperature of the substrate **200** can be controlled in a preferred temperature range, thus making it possible to produce a film or a solar cell having its good property.

Still furthermore, while, in the foregoing embodiment, the catalytic CVD equipment **100** was arranged so as to be provided with only one reaction chamber **10**, this device is not limitative thereto. The catalytic CVD equipment **100** may be provided with a plurality of reaction chambers. In this manner, films of a same kind or films of different kinds can be formed to be superimposed on the substrate **200**.

EXAMPLES

While Examples of the holder according to the present invention will be specifically described hereinafter, the present invention is not limitative to the descriptive matter set forth in the following Examples, and the present invention can be appropriately modified and carried out without departing from the spirit and scope of the invention.

Preparation of Holder

(1) Example 1

As a holder according to Example 1, an aluminum plate was prepared, the plate having a flat holding face and an amorphous silicon layer with its thickness of about 2 microns, the layer being formed on the holding face by means of a catalytic CVD technique.

(2) Example 2

As a holder according to Example 2, an aluminum plate was prepared, the plate having a holding face on which a concave-convex structure is formed and an amorphous silicon layer with its thickness of about 2 microns, the layer being formed on the holding face by means of the catalytic CVD technique, was prepared.

(3) Example 3

As a holder according to Example 3, an aluminum plate was prepared, the plate having a flat holding face and an amorphous silicon layer with its thickness of about 1 micron, the layer being formed on the holding face by means of a catalytic CVD technique, was prepared.

(4) Comparative Example

As a holder according to Comparative Example, an aluminum plate having a flat holding face was prepared.

Comparative Experiments

(1) Experiment 1

First, silicon plates were held as substrates on the respective holders in Example 1 and Comparative Example.

Next, each of the holders was transported into a reaction chamber in which a catalytic wire was arranged, and the substrate and the catalytic wire were disposed so as to be opposed to each other.

Next, the catalytic wire was heated up to the order of 1,600 degrees Centigrade to 2,000 degrees Centigrade, and thereafter, in this state, the heated catalytic wire was left as is, for 300 seconds.

Next, when surface temperatures of the substrates were measured, the measured surface temperature of the substrate that was held on the holder of Example 1 was 300 degrees Centigrade, whereas the measured surface temperature of the substrate that was held on the holder of Comparative Example was about 400 degrees Centigrade.

It is deemed that a reason why such a result was obtained is that, in the holder of Example 1, reflection of the radiant ray permeating through the substrate and hitting against the holder toward the side of the substrate could be restrained by means of the antireflective structure included in the holder.

(2) Experiment 2

First, silicon plates were held as substrates on the respective the holders in Example 2, Comparative Example, and Example 3.

Next, each of the holders was transported in a reaction chamber in which a catalytic wire was arranged, and the substrate and the catalytic wire were disposed so as to be opposed to each other.

Next, a change in the surface temperature of the substrate was measured while the catalytic wire was heated up to the order of 1,600 degrees Centigrade to 2,000 degrees Centigrade. FIG. **7** is a graph depicting a change in each of the surface temperatures of the substrates that are held on the holders in Example 2, Example 3, and Comparative Example.

As shown in FIG. **7**, it was found that the surface temperatures of the substrates that were held on the holders in Example 2 and Example 3 are gently increased in comparison with the surface temperature of the substrate that was held on the holder in Comparative Example.

It is deemed that a reason why such a result was obtained is that, in the holders of Example 2 and Example 3, reflection of the radiant ray that permeates through the substrate and hits

against the holders toward the side of the substrate could be restrained by means of the antireflective structure included in the holders.

In addition, it was found that the surface temperature of the substrate that was held on the holder in Example 2 is gently increased in comparison with the surface temperature of the substrate that was held on the holder in Example 3.

It is deemed that a reason for this finding is that the holder in Example 2 has an amorphous silicon layer with its greater thickness in comparison with that of the holder in Example 3, and that a concave-convex structure is formed on a holding face, whereby reflection of the radiant ray ejected from the catalytic wire on the holding face could be restrained more effectively.

From the foregoing, overheat of the substrate temperature can be restrained according to the present invention; and therefore, it was found that the substrate temperature can be controlled in an appropriate temperature range. In addition, it is deemed that a deposited film with its good film quality and a solar cell with its good solar cell property can be produced by employing the present invention.

It is to be noted that the entire contents of Japanese Patent Application No. 2009-230589 (filed on Oct. 2, 2009) are incorporated in the present specification by reference.

INDUSTRIAL APPLICABILITY

As described above, a catalytic CVD equipment according to the present invention is capable of restraining overheating of a substrate, and is capable of controlling a temperature of the substrate in a preferred temperature range; and therefore, this device is useful in the field of forming a film such as the field of production of solar cell. In addition, a method for formation of film and a process for production of solar cell, according to the present invention, are capable of providing a deposited film with its good film quality and a solar cell with its good solar cell property; and therefore, the method and process are useful in the field of production of solar cell. Further, a substrate holder according to the present invention is useful in the field of production of solar cell, since overheat of the substrate is restrained.

DESCRIPTION OF REFERENCE NUMERALS

10 . . . Reaction chamber
11 . . . Catalytic wire
12 . . . Mount portion
13 . . . Terminal
20 . . . Gas supply pipe
30 . . . Gas exhaust pipe
100 . . . Catalytic CVD equipment
200 . . . Substrate
200A . . . First main face
200B . . . Second main face
300 . . . Holder
300S . . . Holding face
310 . . . Substrate portion
320 . . . Antireflective film
330 . . . Holding structure
400 . . . Holder
400S . . . Holding face
410 . . . Substrate portion
420 . . . Antireflective film

The invention claimed is:

1. A catalytic CVD equipment for performing formation of film by supplying a raw material gas to a catalytic wire that is installed and heated in a reaction chamber and then depositing generated decomposed species on a substrate that is held on a holder in the reaction chamber,
- the holder including an antireflective structure for preventing reflection of a radiant ray that is ejected from the catalytic wire,
- wherein the antireflective structure includes an antireflective film having a thickness of about 1.5 microns to 3 microns and has a concave-convex structure that is provided so as to be opposed to the substrate,
- wherein the antireflective film is provided on a surface of the holder facing a back surface of the substrate, and
- wherein the holder has a substrate portion on which the antireflective film is formed, and the substrate portion is made of aluminum or stainless steel.

2. The catalytic CVD equipment according to claim **1**, wherein the antireflective film includes a silicon-containing film.

3. The catalytic CVD equipment according to claim **2**, wherein the silicon-containing film has at least one structure of the group consisting of an amorphous structure and a crystalline structure.

4. The catalytic CVD equipment according to claim **1**, wherein the antireflective film includes a mixed crystal film.

5. A method of formation of a film using a catalytic CVD equipment according to claim **1**, said method including the step of depositing a film on a substrate to perform formation of film, wherein formation of film of the film is performed by employing the catalytic CVD equipment.

6. A process for production of a solar cell using a catalytic CVD equipment according to claim **1**, said process including the step of depositing a film on a substrate to perform formation of film,
- wherein formation of film of the film is performed by employing the catalytic CVD equipment.

7. A catalytic CVD equipment for performing formation of film by supplying a raw material gas to a catalytic wire that is installed and heated in a reaction chamber and then depositing generated decomposed species on a substrate that is held on a holder in the reaction chamber,
- the holder including an antireflective film comprising a silicon-containing film that is formed on a holding face for holding the substrate,
- wherein the antireflective structure prevents reflection of a radiant ray that is ejected from the catalytic wire, and has a concave-convex structure that is provided so as to be opposed to the substrate,
- wherein the silicon-containing film has a thickness of about 1.5 microns to 3 microns,
- wherein the silicon-containing film is provided on a surface of the holder facing a back surface of the substrate, and
- wherein the holder has a substrate portion on which the antireflective film is formed, and the substrate portion is made of aluminum or stainless steel.

8. A substrate holder for performing formation of film by supplying a raw material gas to a catalytic wire that is installed and heated in a reaction chamber and then depositing generated decomposed species on a substrate that is held on a holder in the reaction chamber,
- the holder including an antireflective structure for preventing reflection of a radiant ray that is ejected from the catalytic wire,
- wherein the antireflective structure includes an antireflective film having a thickness of about 1.5 microns to 3 microns and has a concave-convex structure that is provided so as to be opposed to the substrate,
- wherein the antireflective film is provided on a surface of the holder facing a back surface of the substrate, and

wherein the holder has a substrate portion on which the antireflective film is formed, and the substrate portion is made of aluminum or stainless steel.

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